



LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

UCRL-AR-144636-REV-2

LLNL Chronic Beryllium Disease Prevention Program (CBDPP) Implementation of 10 CFR 850, Revision 2

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June 30, 2005

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LLNL Chronic Beryllium Disease Prevention Program Implementation of 10 CFR 850

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Executive Summary

Beryllium work at LLNL is presently being done under the auspices of its DOE/NNSA Oakland approved Chronic Beryllium Disease Prevention Program.¹ LLNL has had a beryllium control program of long standing, 10 CFR 850 strengthens beryllium controls particularly for non-laboratories. LLNL met, with DOE/NNSA Oakland concurrence, the compliance date of January 7, 2002, for 10 CFR 850 activities.

The working document for the CBDPP is Environment, Safety and Health Manual, Document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements."

This document, revision 2 of the CBDPP, focuses on the status of the CBDPP and its program elements.

This CBDPP expires on July 19, 2006. Changes or updates are due to DOE/LSO at least 90 days prior to its expiration.

¹ LLNL Chronic Beryllium Disease Prevention Program (CBDPP): Implementation of 10 CFR 850, UCRL-AR-144636, August 8, 2002.

DOE/NNSA Livermore Site Office Approval



Department of Energy
National Nuclear Security Administration
Livermore Site Office
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JUL 19 2005

Dr. William A. Bookless
Associate Director for
Safety and Environmental Protection
Lawrence Livermore National Laboratory
P.O. Box 808, L-668
Livermore, CA 94551-0808

Subject: Conditional Approval of Lawrence Livermore National Laboratory Chronic Beryllium Disease Prevention Program (June 29, 2005)

Reference: (a) Letter from William A. Bookless to Camille Yuan-Soo Hoo, *Submittal of the Lawrence Livermore National Laboratory Chronic Beryllium Disease Prevention Program for Approval*, dated June 30, 2005

(b) UCRL-AR-144636-Rev 2, *Lawrence Livermore National Laboratory Chronic Beryllium Disease Prevention Program Implementation of 10 CFR 850 Revision 2*, dated June 30, 2005

(c) 10 CFR 850 Chronic Beryllium Disease Prevention Program

Dear Dr. Bookless:

As requested in reference (a), the National Nuclear Security Administration/Livermore Site Office (NNSA/LSO) reviewed reference (b). In accordance with reference (c) and provided that changes discussed with and agreed to by your Chemical and Biological Safety Section staff (enclosure 1) are included, the Lawrence Livermore National Laboratory (LLNL) Chronic Beryllium Disease Prevention Program (CBDPP) is approved for a period of one year from the date of this letter. To ensure the future timely approval of its CBDPP, LLNL shall annually submit a current copy of its CBDPP with its approved additions and proposed changes at least 90 days prior to the expiration of this approval.

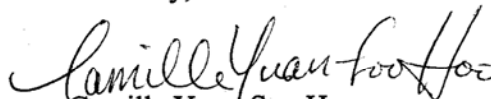
Regarding your concern about LLNL's receipt of beryllium materials from other sites that do not use wet swiping, a Beryllium Health and Safety committee poll on beryllium surface sampling (summarized in enclosure 2) shows that LLNL is the only responding Department of Energy site exclusively using dry swipes to assess beryllium surface contamination. Wet swipe methods used by other sites included ghost wipes, water wetted media and alcohol wetted media.

Just as LLNL now expects that materials it receives are at least cleaned and dry swiped to appropriate release levels, LLNL shall contractually ensure that, where feasible, shipping sites will clean and wet swipe beryllium containing items prior to release and shipment to LLNL. All LLNL receiving verification swiping must be done wet where feasible. It is LLNL's option to return or clean items received from other sites that do not meet release criteria. LSO understands that certain items may not be cleanable and wet swiping is not appropriate for beryllium items that can be damaged by wetting agents or where items may include other chemicals that can react with wetting agents. In those cases, items will be contained in labeled and sealed containers that can be and have been wet swiped and released. For future handling, these items shall be treated as contaminated with appropriate engineering, administrative and personal protective equipment controls in place.

Should LLNL not be able to implement wet swiping on the date of this approval, a record of all items and locations dry swiped after the date of this approval shall be kept. Readily accessible locations and items on that record shall be re-sampled within 30 days after wet swiping has been implemented.

If you have any questions or concerns regarding this matter, please contact Mr. Harvey Grasso at (925) 423-7557.

Sincerely,


Camille Yuan-Soo Hoo
Manager

Enclosures 1) LSOD Document Review and Comment Record (RCR)
 2) Email dated July 6, 2005 (Brisson/Grasso) Subject: Surface
 sampling methods used by DOE sites

cc (w/encl.):

W. Shotts, LLNL, L-005
B. Failor, LLNL, L-382
J. Johnson, LLNL, L-379
G. Fulton, LLNL, L-379

I. Introduction

Revision History

This document supersedes *LLNL Chronic Beryllium Disease Prevention Program (CBDPP): Implementation of 10 CFR 850*, UCRL-AR-144636, rev 1.1, August 15, 2003.

General (10 CFR 850.1 and .2)

Most beryllium work at DOE and DOE Contractor sites is subject to 10 CFR 850, “Chronic Beryllium Disease Prevention Program,” (“The Rule”).^{2, 3} This Rule is applicable to LLNL subject to the following exceptions specified in the noted sections of the Rule:

1. Beryllium articles. (10 CFR 850.2(b)(1))
2. DOE laboratory operations that meet the definition of laboratory use of hazardous chemicals in 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories. (10 CFR 850.2(b)(2))

10 CFR 850 has been formally adopted as a Work Smart Standard, replacing DOE N440.1, by consensus between the LLNL and DOE/NSA Oakland beryllium subject matter experts and approved by the Work smart Standards Change Control Board on April 13, 2000.⁴ This is an “A List,” or regulatory standard, in Contract W-7405-Eng-48, Appendix G.

10 CFR 850 and the required CBDPP are implemented via the *Environment, Safety and Health Manual*, Document 14.4, “Implementation of Chronic Beryllium Disease Prevention Program Requirements,” UCRL-MA-133867. This document provides the necessary operational requirements and guidance for LLNL personnel safe handling of beryllium.

“Beryllium work” is the term LLNL uses to be synonymous with the Rule’s term “beryllium activity.” This is a direct consequence of the LLNL implementation of Integrated Safety Management and its focus on work and hazards.

“Beryllium” is specifically defined by 10 CFR 850 and includes only a small group of materials: elemental beryllium (i.e., beryllium metal), and any insoluble beryllium compound or alloy containing 0.1% beryllium or greater that may be released as airborne particulate.

The definition for “article” is provided in the OSHA Hazard Communication Standard⁵ and interpretation on how to apply it is in the OSHA compliance instruction for its enforcement.⁶ In this CBDPP a “documented beryllium article” is defined as a posted or labeled object or class of objects made of beryllium or a beryllium compound that has been swiped and demonstrated to not be capable of releasing beryllium over time (due to oxidation or corrosion) above the release limit, when stored, handled and used in the ways it is designed or likely to be stored and used.

² 63 FR 66940-66975, “10 CFR 850; Chronic Beryllium Disease Prevention Program, Proposed Rule.”

³ 64 FR 68854-68914, “10 CFR 850; Chronic Beryllium Disease Prevention Program; Final Rule.”

⁴ Change Request and Exemption Form CCB/2000-011, dated April 13, 2000.

⁵ 29 CFR 1910.1200, “Hazard Communication.”

⁶ OSHA Compliance Instruction, CPL 2-2.38D, “Inspection Procedures for the Hazard Communication Standard.”

The definitions for “laboratory” and “laboratory use of hazardous chemicals” are given in the OSHA standard for exposure to hazardous chemicals in laboratories.⁷ Guidance to OSHA’s intent in defining a laboratory is available in the preamble to the final rule.⁸

Beryllium work at LLNL is regulated by 10 CFR 850 and 29 CFR 1910.1450 (for work that is exempted under 10 CFR 850). This CBDPP only addresses 10 CFR 850. Those facilities and laboratories subject to 29 CFR 1910.1450 are covered by *Environment, Safety, and Health Manual (ES&H Manual)*, Volume II, Part 14, “Chemicals,” specifically ES&H Manual Documents 14.1, “Chemicals,” and 14.2, “LLNL Chemical Hygiene Plan for Laboratories.”

Note: Generically, the controls required by *ES&H Manual* Documents 14.1 and 14.2 *do not* differ from those required for beryllium work: the work must be appropriately authorized, controls (engineering, administrative, and personal protective equipment (PPE)) commensurate with the hazard must be established, training is required, personal air sampling is required based on a hazard assessment, medical surveillance is required under certain circumstances, and finally periodic reviews are required for feedback and improvement.

The air standards (action level and permissible exposure limit) and surface contamination standards (housekeeping standard and release criteria) established by 10 CFR 850 apply, as a matter of LLNL policy, to work with beryllium subject to 29 CFR 1910.1450.

Medical surveillance⁹ will be offered to workers in chemical hygiene laboratories potentially exposed to beryllium as in areas subject to 10 CFR 850.

This CBDPP shall be submitted to the Head of DOE/NNSA Livermore Site Office (LSO), as required by 10 CFR 850, Subpart B, for review and approval.

10 CFR 850 assigns DOE/NNSA LSO the responsibility to review the CBDPP annually, or earlier if there is a significant change in or addition to the CBDPP, or if there is a change in contractors. LLNL will annually or earlier, and at least 90 days prior to the expiration date of this CBDPP, provide DOE/NNSA LSO a current list of beryllium operations and any proposed CBDPP changes for review and approval as required by 10 CFR 850.

Copies of the CBDPP are available upon request to the DOE Assistant Secretary for Environment, Safety, and Health or designee, DOE Program Offices, and affected workers or their representatives.

Covered Locations and Workers (10 CFR 850.2)

This CBDPP covers (1) work managed by LLNL at the Livermore Main Site, Site 300, and the Nevada Test Site and (2) any LLNL employee (including former employees of DOE or other DOE-contractors now employed by LLNL) who was exposed or potentially exposed to beryllium

⁷ 29 CFR 1910.1450, “Occupational Exposure to Hazardous Chemicals in Laboratories.”

⁸ 55 FR 3300-3335, “29 CFR Part 1910; Occupational Exposures to Hazardous Chemicals in Laboratories; Final Rule.”

⁹ This differs from medical surveillance that is required by 29 CFR 1910.1450 for workers in chemical hygiene laboratories. That requirement is for medical surveillance for workers with signs or symptoms of exposure; beryllium sensitization is a sign of exposure that is not evident unless medical surveillance is done. Therefore medical surveillance for laboratory workers is to be more inclusive than OSHA would require.

at LLNL or another DOE facility.¹⁰ Other DOE facilities off-site are included in this CBDPP if the work is managed by LLNL; work done at a DOE facility not managed by LLNL will fall under that facility's CBDPP if it is a DOE site.

All LLNL employees (i.e., persons hired and employed by the University of California to work at LLNL) who may be exposed to beryllium in the course of their work are covered by this CBDPP.

The employees of supplemental labor contractors, other contractors, and other non-LLNL entities, who are directed or supervised by LLNL employees and who may be exposed to beryllium in the course of their work at LLNL are covered by this CBDPP, subject to the constraints of the *ES&H Manual*.^{11, 12}

The LLNL Supplemental Labor Policy states (in part):

Supplemental Labor Workers. The supplemental labor policy states that specific subcontract provisions must be in place to allow for work with a likelihood of exposure to substances not generally encountered in similar work in the relevant job category in U.S. industry.

Thus a contract modification may be required before work with beryllium by supplemental labor can commence. Specific details are available in the LLNL Supplemental Labor Policy Manual.

For work that is not supervised or directed by LLNL, the contractor will be required to submit a separate CBDPP. This plan will be approved by LLNL and submitted as an appendix to LLNL CBDPP for approval by the DOE/NNSA LSO.

Dispute Resolution (10 CFR 850.5)

Any worker who is adversely affected by an action taken, or failure to act, under 10 CFR 850 may petition the Office of Hearings and Appeals for relief in accordance with 10 CFR Part 1003, Subpart G, except:

- The Office of Hearings and Appeals may not accept a petition from a worker unless the worker requested the responsible employer to correct the violation, and the responsible employer refused or failed to take corrective action within a reasonable time.
- If the dispute relates to a term or condition of employment that is covered by a grievance-arbitration provision in a collective bargaining agreement, the worker must exhaust all applicable grievance-arbitration procedures before filing a petition for relief with the Office of Hearings and Appeals. A worker is deemed to have exhausted all applicable grievance-arbitration procedures if 150 days have passed since the filing of a grievance and a final decision on it has not been issued.

¹⁰ "DOE facility" means any facility operated by or for the DOE. (10 CFR 850.3, "Definitions").

¹¹ *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume I, Part 2, "ES&H Management Requirements," specifically Document 2.1, "Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management," section 5.2, "Non-LLNL Personnel."

¹² *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume I, Part 2, "ES&H Management Requirements," specifically Document 2.5, "Procured Services Subcontractor Environment, Safety, and Health Program."

Collective Bargaining and Labor Organizations (10 CFR 850.10(d))

Presently there is one group of employees at LLNL working under a collective bargaining agreement. The agreement is between the Security Police Officers Association and the University of California. The relevant clause of the contract is:

Article 9. It is further recognized by the parties to this Agreement that Department of Energy Regulations are the basic authority for establishing and continued implementation of medical/physical/mental standards for employees. Copies of directives regarding implementation or changes thereto will be made to the Association.

If any members of the Security Police Officers Association, or other labor organization that the University of California may enter into a collective bargaining agreement, and if any members of that organization are beryllium associated workers, the University shall

- Give the labor organization timely notice of development and implementation of the CBDPP and any updates, and
- Upon timely request, bargain concerning implementation of 10 CFR 850, consistent with Federal labor laws.

General Requirements (10 CFR 850.11)

ES&H Manual Citation: Document 14.4, §§ 1, 3.1, 3.2, 3.5

Appendix C summarizes current and planned beryllium operations that are under the scope of this Plan, excluding those operations exempt from 10 CFR 850 and subject 29 CFR 1910.1450. Integration of the Plan into the LLNL ES&H Program is discussed generally in the following section, and in detail in Sections II, Parts A-S of this Plan.

This CBDPP and the referenced documents of this Plan establish the Laboratory's commitment and the formal program to:

- Minimize the number of workers exposed or potentially exposed to beryllium
- Minimize the opportunities for workers to be exposed to beryllium
- Establish an exposure reduction and minimization program, commensurate with the risk

The requirement of the Rule (10 CFR 850.11(b)(3)(iii)) to minimize disability and lost work time due to chronic beryllium disease, sensitization, and associated medical care is an existing program that applies to all hazards. This is the Return-to-Work Program established in Appendix C of "Occupational Medical Program."¹³

Implementation (10 CFR 850.12)

ES&H Manual Citation: Document 14.4, §3.1

¹³ *Environment, Safety, and Health Manual*, UCRL-MA-113867, Document 10.1, "Occupational Medical Program."

No beryllium work subject to 10 CFR 850, outside the scope of this CBDPP, may be done unless an addendum to this CBDPP is written and approved by the DOE. DOE/NNSA Livermore Site Office (LSO) has 30 days to approve any submittal under the Rule; unexpected situations may proceed without an update to the CBDPP, but only with the approval of DOE/NNSA LSO Manager. Updates are deemed approved 30 days after submission if not acted upon DOE earlier.

Work outside the scope of this CBDPP is work that is a significant change or addition to that identified in Appendix C, "Current Beryllium Operations." There are no predetermined criteria in DOE/NNSA policy to determine if a change is "significant" and a change to the CBDPP is required. Factors to be considered to determine if a change to the CBDPP is needed are:

- Mission changes
- Medical surveillance findings
- Performance indicators
- Administrative considerations

With these points, the following questions should be asked:

1. Will the proposed operation expose new workers to beryllium?
2. Will the proposed operation make a new contaminated area?
3. Can the work be done in an existing beryllium work area?

Examples of changes that are considered significant or non-significant:

- The amount of work for a particular activity needs to increase, increasing the number of people (who would be classified as beryllium workers) assigned and adding additional shop or laboratory space due to Programmatic need, is a significant change.
- Augmentation of staff for a temporary increase in workload is not a significant change; workers who already have a history of beryllium exposure shall be used whenever practical.
- A new individual starting work in a beryllium work area, replacing a worker who has left that job and is no longer exposed for any reason, is not a significant change.
- A new beryllium task using existing staff in an existing beryllium work area may or may not be a significant:
 - not significant: no new engineering controls
 - significant: new engineering controls
 - not significant: hazard assessment suggests no increase in exposure measurements (see ES&H Manual Document 14.4, §3.5.3, "Hazard Assessments," for protocol)
 - significant: hazard assessment suggests an increase in exposure measurements (see ES&H Manual Document 14.4, §3.5.3, "Hazard Assessments," for protocol)
 - significant: medical surveillance data is suggestive of increase risk for sensitization or disease

- An operation, including assigned staff, moving from one area to another may or may not be a significant change:
 - not significant: operation moves from one contaminated area to another
 - significant: operation moves to an uncontaminated area.

DOE G 440.1-7A, “Implementation guide for use with 10 CFR 850” provides additional points to consider in determining if a change is a significant change.

Notification to the DOE/NNSA LSO of significant changes, additions to the work, or if there is a change in contractors, identified in Appendix C shall be as follows:

1. The LLNL Program proposing the activity shall notify the cognizant ES&H Team who shall review the work.
2. The Program, in consultation with the ES&H Team and the Hazards Control Department, Safety Programs Division, Chemical and Biological Safety Section, Beryllium Subject Matter Expert (CBS/BeSME), shall determine if the proposed work is a significant change.
3. The change, if deemed to be significant, shall be forwarded by memorandum from the appropriate LLNL program manager to the appropriate DOE/NNSA LSO line manager for approval. As an example, the forwarding memorandum can include the following information:
 - i. Name of proposed beryllium work.
 - ii. Description of proposed work.
 - iii. Responsible Individual and telephone extension.
 - iv. Identify and provide copies of the relevant IWS/SP(s).
 - v. Potential beryllium exposure and basis for determination.
 - vi. Worker classification (beryllium worker classification).
 - vii. Description of controls.
 - viii. Statement of how approval of this work is consistent with 10 CFR 850 goals of minimizing exposure and opportunity for exposure.
4. DOE/NNSA LSO line manager will act on the request within 30 days and respond in writing.
5. The record of review and any required changes shall be maintained with the CBDPP in the Hazards Control Department, Safety Programs Division, Chemical and Biological Safety Section.

Upon receipt of the approval from DOE/NNSA LSO, the newly approved operation will become part of this CBDPP.

Compliance (10 CFR 850.13)

Full compliance with all provisions of the Rule was achieved prior to January 7, 2002.

Integration of the CBDPP into the LLNL ES&H Program

This document, the LLNL CBDPP, is not a stand alone document or program, rather it identifies those portions of the LLNL ES&H program, when viewed as a whole, are integrated into the LLNL worker protection programs as required by parts 10 CFR 850.1 and 850.11 of the Rule. The Referenced documents that constitute the program are:

ES&H Manual, Volume I: ES&H Management
ES&H Manual, Volume II: Health & Safety Hazards and Controls
ES&H Manual, Volume III: Environment Hazards and Controls
ES&H Manual, Volume IV: Other Institutional ES&H Documents
Hazards Control Manual
Health Services Department Policies
Chemical & Biological Safety Discipline Action Plan
Industrial Hygiene Policy and Information Manual
LLNL Contract W-7405-Eng-48, Appendix G
LLNL Records Management Program

The specific sections of these documents that apply to the control of beryllium exposure are identified in Section II, parts A-S of this CBDPP.

II. Program Elements.

As previously noted, the working implementation of 10 CFR 850 is through the ES&H Manual, Document 14.4. The following provides the links of each section of 10 CFR 850, Subpart C, “Specific Program Requirements” to the LLNL program.

A. Baseline Beryllium Inventory (10 CFR 850.20)

ES&H Manual Citation: Document 14.4, §3.5

The protocol for the Beryllium Inventory required by §850.20 is documented in a Chemical & Biological Safety Section internal document, “LLNL CBDPP Baseline Beryllium Project.” The results of the inventory are documented in a FileMaker Pro® database, “Baseline Inventory (Legacy).” Figure 1 illustrates the data fields.

Residual surface contamination was evaluated in candidate buildings. Areas evaluated were generally occupied and accessible spaces, that is, not behind or under equipment, above false ceilings, or other inaccessible locations. The database entries are annotated such that the results applied to these areas only; if work is to be done that will disturb un-sampled building areas, structures or equipment, then baseline surface contamination assessments of those areas must be performed prior to the start of work.

The baseline beryllium inventory is managed under the direction of the Beryllium Subject Matter Expert¹⁴ and is conducted by the ES&H Field Team Industrial Hygienists.¹⁵

The data for the Baseline Inventory (electronic files and archived documents) is maintained in the Chemical and Biological Safety Section of the Hazards Control Department, or by institutional data systems (Integration Work Sheet, available at the following url: http://www-r.llnl.gov/es_and_h/iesh_manual/ismworksheet/ismwork.html).

¹⁴ This position was formerly entitled “Industrial Hygiene Technical Leader,” until the 2002 re-organization of the Hazards Control Department. See Hazards Control Department Posting “Industrial Hygiene Technical Leader,” 3/21/97. Incumbent is required to be a certified industrial hygienist.

¹⁵ See Hazards Control Department Posting “Industrial Hygienist,” 5/26/00. Minimum qualifications include a BS degree in a scientific or engineering discipline or equivalent level of demonstrated knowledge and experience and demonstrated experience in comprehensive industrial hygiene practice. Desired qualifications include an MS degree in a scientific or engineering discipline or equivalent combination of education and experience, certification by the American Board of Industrial Hygiene and knowledge of DOE safety policies and procedures.

Beryllium Baseline Inventory Data Entry Form

Building **Room** **GAO**
Field Team ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ D&D'd **Current** ☐ Yes ☐ No ☐ TBD
OSP **IWS**
Identifiable Location? ☐ Yes ☐ No **Location to be assessed** ☐ Yes ☐ No

Comments

Historical Results

↑
↓

Location Description

↑
↓

Ventilation Systems

Active?

Contaminated?

☐ Yes ☐ No
☐ Yes ☐ No
☐ Yes ☐ No
☐ Yes ☐ No
☐ Yes ☐ No

☐ Yes/Presumed ☐ No ☐ TBD
☐ Yes/Presumed ☐ No ☐ TBD
☐ Yes/Presumed ☐ No ☐ TBD
☐ Yes/Presumed ☐ No ☐ TBD
☐ Yes/Presumed ☐ No ☐ TBD

Hazard Assessment

↑
↓

Additional Samples Needed? ☐ Yes ☐ No

Rational

↑
↓

Facility Action Recommended ☐ Yes ☐ No

H&S Tech **Date**

IH

Supporting Data

Batch Number	Batch summary	Sample Number	Results (µg/cm ²)
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Date printed 12/9/2002

?

Figure 1. Sample of Baseline Inventory Data Entry Screen

B. Hazard Assessment (10 CFR 850.21)

ES&H Manual Citation: Document 14.4, §3.5.3

Hazard assessment has been subdivided into two categories:

1. Existing operations
2. Historical operations as identified in the baseline inventory (see Section II, Part A).

The hazards of existing and new beryllium operations, as with all operations at LLNL, are assessed in accordance with the five guiding principles of Integrated Safety Management as implemented in *ES&H Manual*, Volume I, Part 2:¹⁶

1. Define scope of work
2. Analyze hazards
3. Establish controls
4. Perform work
5. Feedback

Beryllium operations posing risk, as defined in *ES&H Manual*, Document 14.4,¹⁷ are reviewed for conformance with LLNL's Integrated Safety Management Program. The process is described in detail in the appropriate sections of the *ES&H Manual*¹⁸ and Industrial Hygiene Program Policy and Information Manual (IHPIM).¹⁹ The results of these reviews are documented in an Integration Work Sheet (IWS). The IWS shall incorporate all necessary controls, including requirements for Safety Plans (SPs), Safety Analysis Documents or Reports (SADs or SARS), or other ES&H documents as needed.

The industrial hygiene hazard assessment process is overseen by the Beryllium Subject Matter Expert and conducted by the ES&H Field Team Industrial Hygienists under the policies and procedures established by the Chemical and Biological Safety Section Leader²⁰ (Section II, Part A for qualifications). IHPIM #50, noted above in the IHPIM (see also Section II, Part E), provides general guidance on hazard assessment. The assessment protocol is established as an LLNL policy in *ES&H Manual*, Document 14.4, section 3.5.3, and takes into consideration the following:

- The amount and nature of work to be performed, including preparation, maintenance, and cleanup.
- The amount of beryllium and chemical form to be used.

¹⁶ *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume I, Part 2, "ES&H Management Requirements," specifically Document 2.1, "Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management."

¹⁷ *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume II, Document 14.4, "Implementation of Chronic Beryllium Disease Prevention Program Requirements."

¹⁸ *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume I, Part 2, "ES&H Management Requirements," specifically Document 2.2, "Managing ES&H for LLNL Work."

¹⁹ IHPIM #50, "Exposure Assessment and Monitoring Plan."

²⁰ Hazards Control Manual, June 8, 2002.

- The potential for aerosol production, including emergency response for spills and unplanned events.
- Historical air, swipe, or other data for similar operations.
- The number of workers involved.
- The number of co-located workers not involved in the work.

Beryllium Associated Worker Definition

A key feature of the hazard assessment process is to determine if the workers are beryllium workers. 10 CFR 850.3 has several definitions that are key to determining if an individual is a beryllium associated worker:

Beryllium means elemental beryllium and any insoluble beryllium compound or alloy containing 0.1 percent beryllium or greater that may be released as an airborne particulate.

Beryllium activity means an activity taken for, or by, DOE at a DOE facility that can expose workers to airborne beryllium, including but not limited to design, construction, operation, maintenance, or decommissioning, and which may involve one DOE facility or operation or a combination of facilities and operations.

Note: This includes the handling of any beryllium containing materials not demonstrated to be documented beryllium articles.

Beryllium-associated worker means a current worker who is or was exposed or potentially exposed to airborne concentrations of beryllium at a DOE facility, including:

- (1) A beryllium worker;
- (2) A current worker whose work history shows that the worker may have been exposed to airborne concentrations of beryllium at a DOE facility;
- (3) A current worker who exhibits signs or symptoms of beryllium exposure; and
- (4) A current worker who is receiving medical removal protection benefits.

Note for clarification: “Beryllium associated worker” (BAW) includes all workers with a potential for airborne exposure to beryllium. The four categories above are special cases of BAWs.

Beryllium worker means a current worker who is regularly employed in a DOE beryllium activity

However, there is ambiguity in these definitions. The term “regularly” is undefined in 10 CFR 850 and in DOE G440.1-7A. “Regularly” in this CBDPP is defined to mean “customary, usual, or normal.” The intent of the definition is to include those individuals assigned to work with beryllium or in beryllium work areas, not individuals who are present in a beryllium work area transiently or who work with beryllium irregularly or intermittently.

As a guideline, “regularly” is taken to mean working with beryllium 10-12 times a year²¹, or approximately once a month. Judgment should be used in applying this definition: workers involved in a less frequent beryllium activity with a potential for higher exposures should be classified as beryllium workers, whereas, workers involved with more frequent beryllium activities with very little potential for airborne exposure might not be considered beryllium workers. This is consistent with the “performance-based” intent of 10 CFR 850.

The simple act of handling a beryllium article would not make an individual a beryllium worker.

For operational purposes, LLNL’s Beryllium Associated Worker roster excludes Beryllium Workers. Beryllium Workers are on a separate roster.

Beryllium-designated Worker (BDW) Definition

LLNL defines “beryllium-designated worker,” or BDW, as a worker assigned to work in a beryllium activity does not presently work with beryllium (and has not worked with it in the past), but may need to at some point in the future.

These individuals may never actually do beryllium work or fall under the scope of 10 CFR 850. However, in the opinion of the responsible individuals, they must be prepared to participate in a beryllium activity on short notice. These employees are offered a baseline Be-LPT test only.

The LPT scheduling process is initiated through enrollment in the beryllium-designated worker roster at Health Services (HSD), usually via auto-enrollment from an authorized eIWS. If and when the worker initiates a beryllium activity he/she will be re-categorized by the responsible individual as either a beryllium worker or a beryllium associated worker. The medical evaluation will be scheduled promptly if the worker accepts the offer. Re-categorization of workers must be done promptly at the initiation of beryllium activities and may be done automatically by updating the eIWS or by contacting the ES&H team clinician. This must be done promptly at the commencement of beryllium activities so that the rest of the baseline exam can be completed.

Areas where beryllium work is done, or where beryllium use is incidental to other research, is extracted from the “Hazard Assess & Initial Monitoring” database and is summarized in Appendix C, Current Beryllium Operations. Work related to repair, maintenance, decommissioning, and monitoring of equipment and facilities that are part of or support these operations are considered “Current Beryllium Operations.”

For historical operations, see Section II, Part A, “Baseline Inventory,” of this document.

C. Exposure Standards (10 CFR 850.22 and .23)

ES&H Manual Citation: Document 14.4, §3.3

It is LLNL policy that beryllium hazards will be controlled to assure that no worker is exposed to airborne beryllium in excess of the permissible exposure limit (PEL), $2 \mu\text{g}/\text{m}^3$, as an 8-hour time weighted average.²² This is done through implementation of existing LLNL programs (see Section II. Part B, “Hazard Assessments,” above).

²¹ Note: each day of a beryllium activity is counted separately.

²² *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume II, Document 14.4, “Implementation of Chronic Beryllium Disease Prevention Program Requirements.”

LLNL adopted $0.2 \mu\text{g}/\text{m}^3$, as an 8-hour time weighted average, as the Action Level for beryllium work in the LLNL beryllium control program prior to 10 CFR 850. This standard will continue to apply to LLNL beryllium work.

Compliance with the Action Level and PEL is determined by taking a sufficient number of samples to ensure a 95% confidence level.²³ See also Section D.

²³ DOE G 440.1-7A, "Implementation Guide for use with 10 CFR 850, Chronic Beryllium Disease Prevention Program." This document provides guidance that is most relevant to routine operations, non-routine operations, such as D&D, present challenges in stratifying or segmenting workers into exposure groups. Chapter 4, "Exposure Assessment: Establishing Similar Exposure Groups," in J. R. Mulhausen and J. R. Damiano, *A Strategy for Assessing and Managing Occupational Exposures*, provides additional guidance (this is cited in DOE G 440.1-7A).

D. Exposure Monitoring (10 CFR 850.24)

ES&H Manual Citation: Document 14.4, §3.5

Exposure monitoring for chemical exposures is the responsibility of the ES&H Team Industrial Hygienists under the direction of policies and procedures established by the Chemical & Biological Safety Section Leader.²⁴ Non-routine personal sampling is typically handled by the Industrial Hygienists; routine personal sampling (periodic monitoring when required) is identified in the Chemical & Biological Safety Discipline Action Plan (CBS DAP Field Instruction #22),²⁵ and typically is performed by the Health and Safety Technicians under the direction of the ES&H Team Industrial Hygienist.

ES&H Manual Document 14.4 promulgates the following personal sampling requirements:

- Initial monitoring for areas that may have airborne beryllium
- Periodic monitoring shall be performed quarterly when exposures exceed the Action Level
- Additional monitoring when changes specified in 10 CFR 850.24(d) take place or are suspected to have occurred.

ES&H Manual Document 14.4 and IHPIM #52²⁶ promulgates the following requirements:

- Notification of all affected workers of personal monitoring results within 10 days of receipt,
- Notification of the DOE/NNSA LSO and the Medical Director if exposures are at or above the Action Level.

The current LLNL exposure assessment program is documented in IHPIM #50²⁷ which provides general guidance in exposure assessment. IHPIM #50 addresses the following topics:

- Monitoring methodology (personal air, area air, and surface sampling)
- Initial characterization
- Qualitative assessment
- Quantitative assessment
- Data interpretation and reassessment

A variety of references are available for exposure assessment methodologies, such as the AIHA's *A Strategy for Assessing and Managing Occupational Exposure* or DOE's *Occupational Exposure Assessment*. The OSHA expanded health standards also provide guidance for when

²⁴ IHPIM #52, "Personal Exposure Reports."

²⁵ Chemical/Biological Safety DAP Instruction 22: Beryllium Monitoring," January 26, 2005.

²⁶ IHPIM #52, "Personal Exposure Reports."

²⁷ IHPIM #50, "Exposure Assessment and Monitoring Plan."

sampling may be discontinued (see, for example, 29 CFR 1910.1027). The appropriate methodology for a given workplace situation is determined by the cognizant industrial hygienist.

E. Exposure Reduction and Minimization (10 CFR 850.25)

ES&H Manual Citation: Document 14.4, §§ 3.1, 3.2, 3.4

The Rule requires a formal exposure minimization program when exposures exceed the Action Level. Therefore a formal exposure reduction and minimization program is not normally required. Nonetheless, exposure minimization is still required, if practicable.

As of the date of this revision, LLNL has one area, the Contained Firing Facility in Building 801, that has a formal exposure reduction and minimization program; the full text of the DOE/LSO approved program is provided in Appendix D.

LLNL policies and programs to control exposures to hazardous materials, including beryllium, are promulgated in the *Environment, Safety, and Health Manual*²⁸. Relevant sections on engineering controls, administrative controls, and personal protective equipment are in Volume I (ES&H Management) and Volume II (Health & Safety Controls). Through this manual the applicable Work Smart Standards are implemented.

ES&H Manual, Document 14.4, “Implementation of the Chronic Beryllium Disease Prevention Program Requirements,” provides specific guidance on controlling exposure to beryllium regardless if the exposure exceeds or is below the Action Level. Document 14.4 specifies that the order of controls is to follow the conventional industrial hygiene hierarchy: first engineering control, then administrative control, lastly personal protective equipment when other controls are inadequate or while other controls are being implemented.

The specific Laboratory policy for keeping exposures to hazardous materials (including beryllium) as low as reasonably achievable is set forth in the *ES&H Manual*, Document 2.1, “Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management,” specifically section 3 of this document.

If exposures are measured above the Action Level, or if a hazard assessment indicates the potential for exposure above the Action Level, a formal exposure reduction and minimization program will be established to minimize both the number of employees exposed and the potential opportunities for exposure. The program will include the following elements:

- Annual goals for exposure reduction and minimization
- A rationale and strategy for meeting those goals
- Actions to be taken to meet those goals
- A means of tracking progress toward those goals or demonstrating that they have been met.

When measurable levels of beryllium are found in personal air samples, but levels are below the Action Level, the following actions are to be considered to further reduce worker exposures:

²⁸ Environment, Safety, and Health Manual, UCRL-MA-113867.

- Review the operation with the worker or worker(s) involved, and their supervisor.
- Verify that engineering controls are working properly, and determine if improvements are feasible.
- Review work practices to determine if there were deviations from accepted practices, or if changes should be effected.
- Arrange to conduct further air sampling to either validate exposures (if no change to controls have been made) or to establish a new baseline for exposures (if changes to controls were made).

In each case, consideration shall be given to the relative magnitude of the exposure. Priority for review and action shall be given to operations that approach the Action Level; measured exposures that are slightly above the detection level, and well below the Action Level do not require the same level of attention as higher exposures.

F. Regulated Areas (10 CFR 850.26)

ES&H Manual Citation: Document 14.4, §3.5

At this point in time, there is one regulated beryllium work area at LLNL. This is the B-801 Contained Firing Facility, see Appendix D for the Exposure Reduction and Minimization Program. All current sampling data indicates exposure for routine operations are less than the Action Level of $0.2 \mu\text{g}/\text{m}^3$. There have been a small number of excursions above the Action Level.

Personal air sampling is conducted as necessary (see Section II, Part D. Exposure Monitoring (10 CFR 850.24)) for new operations. If exposures exceed, or can reasonably be expected to exceed, the Action Level, then a regulated area will be established. Regulated areas may be of two types: (i) indoor work areas or (ii) outdoor areas.

When established, both indoor and outdoor regulated areas will be posted with a sign with the following wording at all access points:

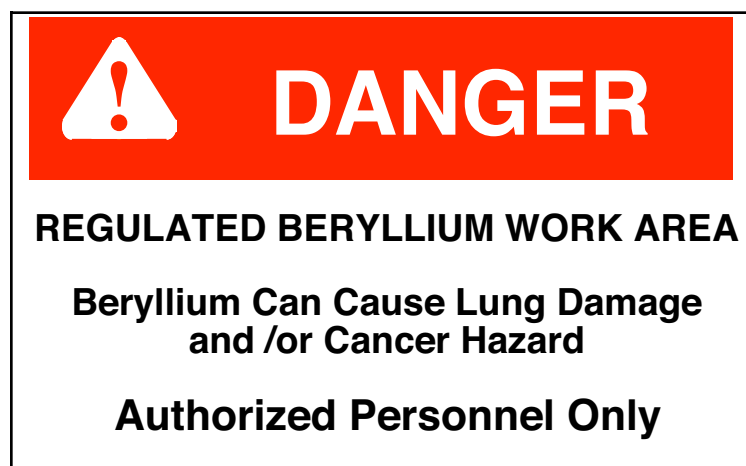


Figure 2. Regulated Area Posting

The following information will be recorded when a regulated area is established:

- Name
- Date
- Time in, time out
- Work performed

Indoor regulated areas for permanent operations will be maintained at negative pressure with respect to other operational areas unless not feasible. For temporary activities, regulated areas will be established using proven protocols to contain and control contamination. See, for example, Appendix F of the OSHA asbestos in construction standard.²⁹

Outdoor regulated areas will be established as needed.

Regulated areas may be temporary or permanent. Temporary regulated areas will exist only when measured exposures meet or exceed the Action Level, and will be disestablished when exposures are reduced below the Action Level. Outdoor regulated areas are expected to be temporary and dependent on the specific activity.

G. Hygiene Facilities and Practices (10 CFR 850.27)

ES&H Manual Citation: Document 14.4, §3.7

Hygiene facilities (change rooms, showers, and handwashing facilities) are closely linked with regulated areas.

If required, temporary or permanent hygiene facilities will be established using proven protocols for controlling and containing contamination. See reference (30) of Section II, Part F, “Regulated Areas,” for specifics.

If exposures are measured at or above the Action Level, the following practices and facilities will be established:

- General
 - food, beverage, or tobacco products shall not be used in the regulated area
 - cosmetics shall not be applied in the regulated area
 - beryllium workers shall not exit regulated areas with contamination on their clothing
- Change Rooms shall be provided for regulated areas
 - separate facilities free of contamination shall be provided for workers to change into and store personal clothing, clean protective clothing and equipment
 - change room shall be maintained at negative pressure or located so as to minimize the spread of contamination

²⁹ 29 CFR 1926.1101, “Asbestos.”

- Showers and handwashing facilities shall be provided for regulated areas and shall be used at the end of the shift
- Lunchroom facilities shall be established for regulated areas
 - readily accessible facilities shall be provided that are free of beryllium and do not result in exposures above the Action Level
 - workers shall not enter the lunchroom with protective clothing or equipment unless contamination has been removed with HEPA-vacuuming or other methods that remove beryllium without dispersing it.

29 CFR 1910.141, Sanitation, which applies to the facilities required by this section has been adopted as a Work Smart Standard.

H. Protective Clothing and Equipment (10 CFR 850.28 and .29)

ES&H Manual Citation: Document 14.4, §§3.6, 3.9

The LLNL Work Smart Process has adopted 29 CFR 1910 Subpart I, “Personal Protective Equipment,” which includes sections 1910.132, “General Requirements” and 1910.134, “Respiratory Protection” as contractually binding³⁰. These are presently implemented, in part, by appropriate sections of the *ES&H Manual*, Volume II, Document 14.4 and Document 11.1, “Personal Protective Equipment.” Specific Respiratory Protection Program implementation is through the Lawrence Livermore National Laboratory Respiratory Protection Program (LLNL RPP).³¹ The types of personal protective equipment to be used shall be determined by a hazard assessment and will be suitable to protect against inhalation, skin contact (including penetration of openings in the skin), eye contact as specified below.

Respirators, when used, shall either be NIOSH-certified or approved by DOE for use.

The LLNL RPP, Chapter 2, “Respirator Selection” addresses voluntary use of respirators for any hazardous material, including beryllium. A respirator will be provided, if requested even if not needed, but all aspects of the respiratory protection program apply (medical qualification, fit testing, training, and hazard assessment).

The general requirements for protective clothing are addressed in *ES&H Manual*, Document 11.1, “Personal Protective Equipment,” and expanded upon in Document 14.4:

- PPE is required when airborne Be is measured at or above the Action Level
- PPE is required when surface contamination levels are above the housekeeping standard
- PPE is required when requested by a beryllium-associated worker
- Procedures are required for donning/doffing, handling, and storing PPE that prevent workers from exiting contaminated areas with beryllium on their clothing or entering contaminated areas without full-body protective clothing

³⁰ Prime Contract W-7405-ENG-48 (“Contract 48”), Appendix G, “DOE Directives,” specifically “Work Smart Standards Set for LLNL,” effective November 4, 1999.

³¹ This document, approved 10/24/00, replaces earlier IHPIMs #150 through #157.

- Prohibition from removing contamination in such a manner that will disperse it into the air
- PPE shall be maintained to ensure its effectiveness
 - if contaminated, shall be handled in such a manner to prevent spread of contamination
 - if contaminated, appropriate information and procedures shall be provided to organizations that launder the PPE to preclude exposure to their employees.

I. Housekeeping (10 CFR 850.30)

ES&H Manual Citation: Document 14.4, §§3.8, 3.13

As directed by DOE/LSO, evaluation of surface contamination will be done “wet.” No single method for evaluating surface contamination has been officially promulgated by the DOE. The Preamble to the Final Rule³² recommends:

To reduce the variability in reported surface contamination across the DOE complex, DOE recommends, but does not require, the use of a single sampling method; NIOSH method 9100 (NIOSH Manual of Analytical Methods, 4th Edition. August 14, 1994. Lead in Surface Wipe Samples.)

LLNL will follow the recommendation of the Preamble. The NIOSH 9100 method specifies the use of sterile cotton gauze, 2” x 2”, or ashless quantitative filter paper, moistened with distilled water.

Other methods of surface evaluation are being discussed in a draft DOE guidance document for managing areas with low levels of beryllium contamination.

In cases where a wet technique will damage a surface, render it unsuitable for use, or will cause other safety concerns (eg, reactivity) surface evaluation will be done dry.

The housekeeping standard, 3 $\mu\text{g}/100\text{ cm}^2$, promulgated in 10 CFR 850.30 is consistent with the maximum level previously established by the LLNL beryllium control program for designated beryllium work areas. The Chemical & Biological Safety Discipline Action Plan, Instruction #22, “Beryllium,” addresses periodic surface sampling, including non-operational periods.

The Rule limits surface contamination levels to 3 $\mu\text{g}/100\text{ cm}^2$ during non-operational periods, but does not define “non-operational period.”³³ The preamble to the final rule states that it is not the intent to require sampling during the work shift. LLNL has made an operational definition of “non-operational period” consistent with the preamble:

- For ongoing, routine operations (i.e., production-type activities)—The end of the work shift or shifts, if work extends over one more consecutive shifts.

³² 64 FR 68885-8, Section 850.30–Housekeeping and Section 850.31–Release criteria.

³³ DOE G 440.1-7A provides the following guidance and requirement for when surface sampling is not required: “Surface sampling for housekeeping purposes is not required in non-operational, closed-off rooms or in buildings where workers will not be exposed to beryllium contamination. Likewise, sampling is not required in the interior of installed closed systems, such as enclosures, glove boxes, or ventilation systems (10 CFR 850.30(a).”

- For specific jobs (i.e., non-production or isolated activities)—The conclusion of the work, even if the work extends over 2 or more days. For long-term operations, the first definition applies.

During the operation, the work shift will meet the OSHA standard for housekeeping which states³⁴:

29 CFR 1910.141(3)(i) All places of employment shall be kept clean to the extent that the nature of the work allows.

This will be tempered with the release criteria of 0.2 $\mu\text{g}/100\text{ cm}^2$ for surface contamination to minimize the potential for exposure. The surface criteria standards apply to those items and equipment that the handling of which may result in exposure if surface contamination is present. They do not apply to the interiors of chambers, enclosures, ventilation systems, and the like, used to control beryllium exposure.

The *ES&H Manual*, Document 14.4 provides requirements for decontamination consistent with the Rule:

- Decontamination of areas and equipment shall be performed regularly
- Only wet methods that do not produce an aerosol or HEPA-equipped vacuums shall be used for cleanup
- Equipment that is potentially contaminated shall be labeled
- Compressed air or dry cleaning shall not be used to clean items where beryllium contamination may be present
- Items used for cleaning beryllium contamination shall not be used for the clean-up of non-hazardous materials.

HEPA-filtered systems shall be maintained and evaluated for collection efficiency as required by existing LLNL policy and procedures.^{35, 36}

The Chemical & Biological Safety Discipline Action Plan for facilities in Chemical & Biological Safety Field Instruction #22, “Beryllium” lists those areas that require periodic surface sampling for both housekeeping purposes and to determine the level of surface contamination present during non-operational periods. The frequency of sampling is dependent on the nature and frequency of the work. Frequency is determined by cognizant IH, as a minimum where there is a potential for airborne beryllium initial monitoring shall be performed; if measurements exceed the action level, then personal sampling shall be performed quarterly at a minimum. The general guidance is that a new or uncharacterized operation will have surface sampling done at a greater frequency; guidance is provided in Appendix C to ES&H Manual Document 14.4. As information about the process is gathered, the sampling frequency may change to longer or shorter intervals. Sampling locations are also determined by the cognizant IH, in consultation with the Health and Safety Technician for the area. Consideration is given to the nature of the process, how the worker handles the parts and equipment used to work the part, and the flow of material through the shop or laboratory. Consideration is also given to handling items that are not

³⁴ 29 CFR 1910.141(3)(i), “Sanitation: housekeeping.”

³⁵ *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume I, Part 12, “General H&S Control-Safety Equipment and Facilities,” specifically Documents 12.2, “Ventilation,” 12.5, “High-Efficiency Particulate Air (HEPA) Filter System Design Guidelines for LLNL Applications.”

³⁶ Chemical/Biological Safety DAP Instruction 72, “Toxic Material Vacuums,” April 26, 2001.

part of the process (for example, telephone, door handles, floors, etc.) that would indicate lack of control if contamination were found.

Non-beryllium work areas adjacent to beryllium work areas are also covered by Chemical & Biological Safety Field Instruction #22, “Beryllium.” Sampling shall follow the statistical protocol outlined in CBS PIM #89.³⁷

J. Release Criteria (10 CFR 850.31)

ES&H Manual Citation: Document 14.4, §§ 3.3, 3.9, 3.13

See the previous section for the protocol for evaluating surface contamination.

Policy and procedure for release of equipment is established in *ES&H Manual*, Document 21.5, “Requirements for Transfer of Equipment and Property for Repair, Reuse, Maintenance, Storage, Excess, or Scrap”³⁸ This document addresses general requirements applicable to all hazardous materials.

The Rule establishes two release criteria both of which are promulgated in ES&H Manual Document 14.4: one of $3 \mu\text{g}/100 \text{ cm}^2$ and one of $0.2 \mu\text{g}/100 \text{ cm}^2$ which also requires items to be labeled with a beryllium contamination warning, even if cleaned. The Rule also establishes the policy that items shall be cleaned to the lowest level practicable, and if items are to be released or work areas downgraded cleaned to levels not in excess of these criteria.

The $3 \mu\text{g}/100 \text{ cm}^2$ level is required for release of material to another facility performing work with beryllium. Prior to transfer or shipment, potentially beryllium-contaminated items shall be cleaned to the extent practical taking into consideration the nature of the item and its subsequent use. For the purposes of this Rule, LLNL considers the term “facility” to mean collectively all locations where beryllium work is done at LLNL, i.e., all LLNL beryllium work areas constitute one facility.³⁹ Therefore, for parts being transferred from one shop or laboratory to another within a building, or to a different building for further work, this limit does not apply. The $3 \mu\text{g}/100 \text{ cm}^2$ release criteria applies when equipment or other items are released to a beryllium work area in another DOE/NNSA facility.

The $0.2 \mu\text{g}/100 \text{ cm}^2$ level applies to release of potentially contaminated equipment to the public, non-beryllium work areas of other DOE/NNSA facilities, or non-beryllium work areas of LLNL. Non-beryllium work areas at LLNL are specially excluded from the “one facility” interpretation noted in the preceding paragraph.

Release of items to non-beryllium work areas or non-DOE/NNSA facilities is contingent upon the recipient’s commitment to implement controls that will prevent foreseeable beryllium exposure. This policy is clearly delineated in *ES&H Manual*, Document 14.4.

³⁷ CBS PIM #89, “Beryllium Surface Contamination Sampling Plan for Use with ES&H Manual Document 14.4,” October 25, 2004.

³⁸ *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume II, Document 21.5, “Requirements for Transfer of Equipment and Property for Repair, Reuse, Maintenance, Storage, Excess, or Scrap.”

³⁹ See DOE interpretation D00-03-003; in part, the interpretation is “CFR 850.31 was not intended to address specific beryllium components between one operating area to another operating area at the same site”.

Labeling is required for all items, regardless of destination. Appropriate packaging is required to prevent potential exposure to beryllium dust. Existing LLNL policy presently requires both labeling of contaminated items or containers of beryllium containing materials and proper packaging. See Section II, Part Q, “Warning Signs and Labels,” for specific wording requirements.

K. Waste Disposal (10 CFR 850.32)

ES&H Manual Citation: Document 14.4, §3.11

The Rule does not establish new requirements, other than labeling addressed in §850.38, for the handling of beryllium or beryllium-contaminated waste. The requirements for disposal of all hazardous waste are implemented by *ES&H Manual*, Volume III, “Environmental Hazards and Controls” (formerly *Environmental Compliance Manual*),⁴⁰ and *Waste Acceptance Criteria* (WAC).⁴¹ The following identifies the types of waste at LLNL that may contain beryllium and notes the applicability of 10 CFR 850:

Description	Typical Waste Stream	Applicability of 10 CFR 850
Aqueous waste with low other toxic organics	Low-level radioactive coolant wash waters with low concentrations of organic compounds, metals and/or other toxic materials generated from operations such as machining. Wash waters may contain beryllium.	Not applicable unless solid residue is present (>0.1% Be)
Spent acid with metals	Low-level radioactive acidic solutions and rinse waters with metals generated from research activities including electroplating and metal finishing operations. Wastes may include plating baths, chromic acid mixtures and nitric acid solutions from bright dip tanks, with at least one or more of the following metals: chromium, copper, aluminum, nickel, zinc, cadmium, lead, or beryllium.	Not applicable unless solid residue is present (>0.1% Be)
Waste oil	Low-level radioactive waste oils generated from laboratory research and machine shop operations. Wastes may include hydraulic and vacuum pump oils, uranium, beryllium, mercury and/or solvents.	Not applicable unless solid residue is present (>0.1% Be)
Metal scale, filings, or scrap	Low-level radioactive lead pieces and bricks contaminated with depleted uranium and/or beryllium during off-site explosion and/or projectile research activities.	Applicable
Spent solid filters or adsorbents	Spent HEPA filters and absorbents generated by research activities and facility maintenance. Wastes	Applicable

⁴⁰ *Environment, Safety, and Health Manual*, UCRL-MA-113867, Volume III, “Environmental Hazards and Controls.”

⁴¹ Environmental Protection Department, *Waste Acceptance Criteria*, UCRL-MA-115877 Rev. 1, August 1997.

Description	Typical Waste Stream	Applicability of 10 CFR 850
	may contain low-level radioactivity, solvents, lead, beryllium, and/or cadmium.	
Other waste inorganic solids	Low-level radioactive inorganic trash generated by research and laboratory cleanup activities. Wastes may include pipettes, funnels, beakers, gloves, paper, filters, plastics, sponges, floor dry, and other lab trash. Wastes may be contaminated with beryllium, lead, and/or low-level radioactive materials.	Applicable unless Be is soluble

Specific waste handling requirements and guidelines are outlined in *ES&H Manual*, Volume 3, Document 36.1, “Waste Management Requirements.” The specific labeling requirements of the Rule are in place.

The Laboratory’s policy for waste minimization applies to all hazardous materials, not just beryllium. The Laboratory’s ES&H policies, including waste minimization are available at http://www.llnl.gov/es_and_h/policies.html. These are implemented through the *ES&H Manual*. The waste minimization program is detailed in *ES&H Manual*, Volume III, Document 30.1, “Waste Minimization and Pollution Prevention.”

L. Emergencies (10 CFR 850.33)

ES&H Manual Citation: Document 14.4, §§ 3.3, 3.12

For the purposes of this section, an emergency is an unplanned event (e.g., accidental exposure, spills, loss of containment, and fire) involving beryllium. LLNL has adopted 29 CFR 1910.120 in its entirety as a Work Smart Standard. The specific sections adopted by the Rule are 1910.120(l), “Emergency response by employees at uncontrolled hazardous waste sites,” and 1910.120(q), “Emergency response to hazardous substance releases.” These sections are implemented by the LLNL Emergency Management Program through the *ES&H Manual*, Volume II, “Health & Safety Hazards and Controls” and Volume III, “Environment Hazards and Controls.” The LLNL Emergency Management Program implements DOE Order 151.1, “Comprehensive Emergency Management System,” which incorporates requirements of 29 CFR 1910.120.

LLNL has no uncontrolled hazardous waste sites so that portion of 29 CFR 1910.120 is not applicable.

M. Medical Surveillance (10 CFR 850.34)

ES&H Manual Citation: Document 14.4, §3.5

Beryllium Associated Workers

Medical services (in part: medical surveillance, medical approvals for respirator use, emergency medical care and treatment, laboratory tests and clinical procedures) are provided by the Health Services Department, which is a department of LLNL under the Associate Director for Safety and Environmental Protection. It is headed by the LLNL Medical Director (the Site Occupational Medical Director, or “SOMD,” in the terminology of 10 CFR 850) and is staffed by licensed health care professionals.

The Beryllium-associated workers roster⁴² (BAWs) was originally developed by the Baseline Beryllium Inventory (see Section II, Part A), the Hazard Assessment (see Section II, Part B), a site-wide employee survey conducted as part of Beryllium Awareness Refresher Training, and a review of previously submitted Beryllium Occupational History Questionnaires. Beryllium work since that time has been identified through the LLNL ISM process via the eIWS; new individuals identified through this process are added to the BAW roster when appropriate. The definition for “beryllium worker” is promulgated in ES&H Manual Document 14.4; the same protocol is used to classify workers who may have been exposed or potentially exposed to airborne beryllium from former LLNL, DOE, or DOE-contractor employment. This list is maintained by the Health Services Department.

Beryllium medical surveillance follows the requirements of 10 CFR 850 and is outlined in a Health Services Department internal document, “Health Services Department: LLNL/HSD Beryllium Medical Surveillance Program.”⁴³ The examinations have the following components:

Baseline examination for Beryllium Associated Workers:

- Medical and occupational history
- Respiratory history
- Physical examination, with pulmonary and skin emphasis
- CXR PA
- Spirometry, with FVC and FEV1
- CBC, SMA12
- Be-LPT

The offer of the LPT will be made before work commences. The remainder of the baseline examination will be offered as soon as possible after work commences.

Beryllium Workers (annual examination)

- Medical and occupational history
- Respiratory history
- Physical examination, with pulmonary and skin emphasis
- CXR PA
- Spirometry, with FVC and FEV1
- CBC, SMA12

⁴² Beryllium-associated worker, or BAW, is

A current worker who is or was exposed or potentially exposed to airborne concentrations of beryllium at a DOE facility, including:

1. A beryllium worker.
2. A current worker whose work history shows that the worker may have been exposed to airborne concentrations of beryllium at a DOE facility, including workers who self-identify as having past exposure.
3. A current worker who exhibits signs or symptoms of beryllium exposure.
4. A current worker who is receiving medical removal protection benefits.

⁴³ James P. Seward, MD, MPP, “Health Services Department: LLNL/HSD Beryllium Medical Surveillance Program,” approved March 23, 2001.

- Be-LPT

Beryllium Associated Workers (every 3 year examination)

- Medical and occupational history
- Respiratory history
- Physical examination, with pulmonary and skin emphasis
- CXR PA (every 5 years)
- Spirometry, with FVC and FEV
- CBC, SMA12
- Be-LPT

Workers may opt for all, part or none of the evaluation. If workers accept the offer they will receive the following:

- An offer for beryllium medical surveillance examination that includes a brief description of the program, noting that participation is voluntary, and providing a brief description of the employee's rights under the rule, including the right for a second medical opinion.
- Beryllium Occupational History Questionnaire
- Health Services Department standard physical forms
- The approved consent form for beryllium medical surveillance
- Respirator approval form
- Beryllium Frequently Asked Questions (Appendix D from DOE G-440.1-7A)

Beryllium Occupational History Questionnaires are forwarded to the Chemical and Biological Safety Section of the Hazards Control Department who will coordinate their review. The cognizant Industrial Hygienist will review the questionnaire and determine the appropriate exposure classification for the worker (beryllium associated worker or beryllium designated worker). The questionnaire will be returned to HSD for inclusion in the workers medical chart.

Beryllium-designated Workers

Beryllium-designated workers (BDW) will be offered a one-time baseline LPT. If the nature of their work changes, the responsible individual for the IWS must recategorize the individual and the worker will be offered requisite medical evaluations as a BAW or BEW.

BDW workers will receive:

- The approved consent form for beryllium LPT
- Beryllium Frequently Asked Questions (Appendix D from DOE G-440.1-7A)

All workers are encouraged to review the medical portion of the Rule prior to the exam appointment and to discuss any questions or concerns with a clinician regarding potential exposures, risks of sensitization. If an employee desires a second medical opinion, HSD will arrange this for the employee promptly in compliance with the Rule. A recommendation will be made for referral to an external occupational medicine specialist familiar with Be LPT screening tests and CBD at no expense to the employee. HSD staff will work closely with the external physician and the employee to facilitate this in accordance with the Rule.

OSHA reporting of adverse health effects from beryllium exposure currently follows OSHA requirements^{44, 45} and not the requirements of the Rule; the DOE issued a clarification on May 21, 2002, confirming this approach.⁴⁶ The essential points are that work related chronic beryllium disease is to be reported on OSHA Form 300 and sensitization will be reported through the DOE Beryllium Registry (see Section II, Part R).

Data analysis (medical, job, and exposure data) is addressed in Section II, Part S, Performance Feedback of this CBDPP.

N. Medical Removal (10 CFR 850.35)

ES&H Manual Citation: Document 14.4, §§ 3.5, Appendix B

LLNL established Medical Protection Requirements for current and prospective employees. The details are provided in Appendix B to ES&H Manual Document 14.4. This policy is consistent with the intent of the Rule.

O. Medical Consent (10 CFR 850.36)

ES&H Manual Citation: Document 14.4, §3.5

The medical consent form required by the Rule is addressed under Section II, Part M, Medical Surveillance.

P. Training and Counseling (10 CFR 850.37)

ES&H Manual Citation: Document 14.4, §3.5

Training

The following training classes are established:

HS4256 Beryllium Worker

This training class is required for all beryllium workers. Initial training is required at or before the time of initial assignment. This course shall include the following topics:

- Communication of hazards, controls, signs and symptoms of exposure, and program requirements as required by 29 CFR 1910.1200, "Hazard Communication"
- Contents of the LLNL CBDPP

⁴⁴ 29 CFR 1904, "Recording and Reporting Occupational Injury and Illness."

⁴⁵ US Department of Labor, "Recordkeeping Guidelines for Occupational Injuries and Illnesses," September 1986.

⁴⁶ Beverly A. Cook, Assistant Secretary for Environment, Safety and Health to distribution, "Clarification of Title 10 of the Code of Federal Regulations, Part 850 (10 CR 850), Chronic Beryllium Disease Prevention Program, Paragraph 850.34(g)," dated May 21, 2002.

- Potential health risks to a beryllium worker's family members due to contact with beryllium on the worker, worker's clothing, or personal items

Retraining is required every two years (after the completion of HS4256) for all beryllium workers, or sooner if there is reason to believe a worker lacks proficiency, sufficient knowledge, or understanding to work safely with beryllium. Retraining is required if there are new hazards or controls about which the worker has not been trained. Retraining will be handled by repeating HS4256, or alternatively successfully completing a challenge test.

HS4257-W Beryllium Safety

This web-based course is required for beryllium-associated workers who are not beryllium workers; re-training is required every two years. The material covered is similar to HS4258, Beryllium Awareness, but provides a greater amount of health related information that is germane to workers with a history of prior, but not current exposure, or for those with signs or symptoms of sensitization or beryllium disease, or who are receiving medical removal protection benefits.

HS4258-W Beryllium Awareness HS4258-RW Beryllium Awareness Refresher

The web-based awareness level course is required for all persons working at LLNL, and must be completed within 90 days of beginning work at LLNL. This course must be repeated every two years. This course shall include:

- General awareness about beryllium hazards
- General awareness about beryllium controls

Refresher training is done every two years by a booklet sent to each employee at LLNL, similar to other awareness training programs at LLNL. This refresher training course is given a course number of HS4258-RW.

Documentation of training is kept by LTRAIN.

Counseling

Presently counseling is done as needed by the Health Services, Hazards Control, Human Resources, and other Departments on a case by case basis. The program is established by the HSD Medical Surveillance Program (see Section II, Part M).

Q. Warning Signs and Labels (10 CFR 850.38)

ES&H Manual Citation: Document 14.4, §§ 3.5, 3.11

Warning signs are required by *ES&H Manual*, Document 14.4 that meet the requirements of the Rule, as well as other beryllium postings that are required as LLNL policy.

The following sign is used to post beryllium work areas; it will be retained for areas that are not regulated areas as defined by the Rule:

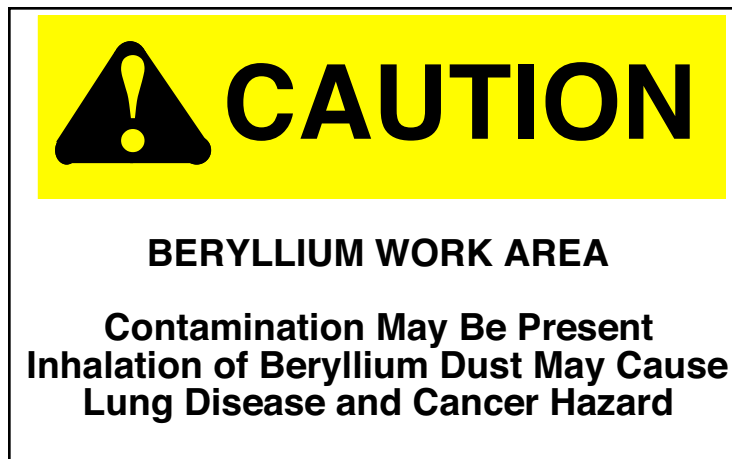


Figure 3. Posting for Beryllium Work Area (non-Regulated)

The posting requirements for regulated areas has been previously discussed, see Section F for details.

ES&H Manual, Document 14.4 requires labeling of contaminated items and equipment using the required language from 10 CFR 850.38:

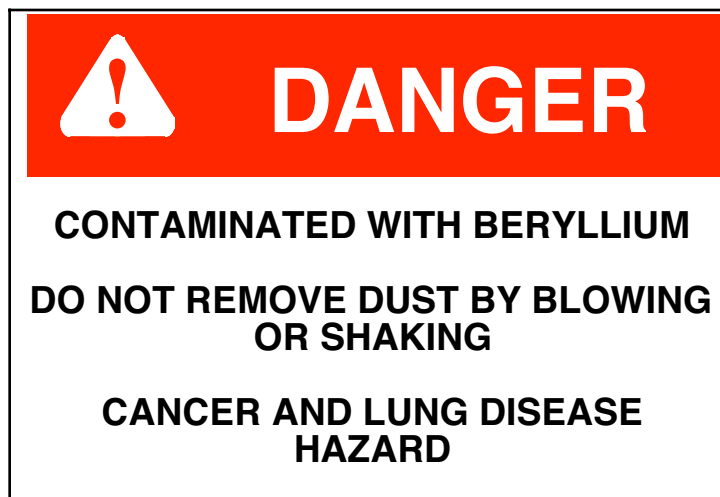


Figure 4. Label for Beryllium Contaminated Items and Equipment

Other labeling shall be as required by 29 CFR 1910.1200, "Hazard Communication," an LLNL-adopted WSS standard.

R. Recordkeeping (10 CFR 850.39)

ES&H Manual Citation: Document 14.4, §3.5

Records Retention

The following records are maintained pursuant to 10 CFR850:

1. Baseline Beryllium Inventory
2. Hazard Assessments
3. Exposure Measurements (air sample and surface sample results)
4. Personal Exposure Reports
5. Medical Surveillance Records

Items 1-4 are maintained by the Hazards Control Department. Item 5 is maintained by the Health Services Department.

Records retention is determined by DOE/NNSA⁴⁷ and LLNL policies. Relevant documents are the LLNL Records Management Policy Guide, LLNL Records Retention Schedule, and Schedule 10 (Environmental Safety and Health)⁴⁸. Medical records access and retention are addressed in the Health Services Medical Records Policy.⁴⁹ The records retention schedule identifies a specific retention frequency (for example, 75 years for industrial hygiene records); however all health related records are covered by the DOE Epidemiological Moratorium which prohibits destruction.

In the event LLNL is no longer involved in beryllium work covered under this CBDPP, all records required by the CBDPP shall be conveyed to DOE/NNSA.

Use of Information

Records generated by the CBDPP (for example: exposure measurements, contamination assessment, hazard assessments, workplace conditions, medical surveillance results, and health outcomes) will be used as required for performance feedback (see Section II, Part S, following) to aid in understanding the beryllium exposure health risk, and when appropriate, measuring progress toward exposure reduction and minimization goals. This information will be maintained in a database that links workplace conditions (including exposure measurements and hazard assessments) and health outcomes (including medical surveillance results).

Beryllium Registry

Information in the records identified above contains the necessary information for the DOE Office of Epidemiology Beryllium Registry. The LLNL data tables are identical with those defined in the DOE's "Beryllium-Associated Worker Registry Data collection and Management Guidance."⁵⁰ Transmission of de-identified information to the DOE is done semi-annually. This process is under the direction of the LLNL Medical Director.

⁴⁷ DOE Epidemiological Moratorium implemented via LLNL Administrative Memo (Policy and Procedure), Vol. 22, No. 10, April 29, 1992.

⁴⁸ Official versions of the relevant documents are maintained on the Archives and Records Management Group web-page at https://www-ais.llnl.gov/llnl_only/docs/bsd/records/records.html

⁴⁹ Access to HSD Medical Records – Policy Statement, December 17, 1998.

⁵⁰ DOE, "Beryllium-Associated Worker Registry Data Collection and Management Guidance," undated.

The requirement of the Rule to protect workers' confidentiality is implemented with the Beryllium Registry: all records are identified by a unique identifier. The key to the unique identifier is held by the LLNL Medical Director.

S. Performance Feedback (10 CFR 850.40)

ES&H Manual Citation: Document 2.1, 4.1

The LLNL implementation of ISM, previously referred to in the *ES&H Manual*, Document 2.1, includes as one of the five functions: Provide feedback for continuous improvement. *ES&H Manual*, Document 4.1, "Directorate Environment, Safety, and Health Self-Assessment Program," Section 2, "Requirements for Self-Assessment Programs" establishes the requirement for each Directorate to conduct ES&H self-assessments. The beryllium control program shall be assessed periodically in those directorates that have work that falls under 10 CFR 850.

The self-assessment shall include, as a minimum, the following topics:

- Monitoring activities.
- Hazards.
- Medical surveillance.
- Exposure reduction and minimization.
- Occurrence reporting data.

A comprehensive program review checklist has been developed based on the requirements of the Rule and is available for use.

Following the guidance of *ES&H Manual*, Document 4.1, the self assessment can be conducted by ES&H support organizations, outside contractors or consultants selected by the directorate, or workers conducting or managing the operation or facility; the self-assessment teams may include members from organizations in other directorates.

Appendix A. Acronyms and Abbreviations

AL	Action Level
BAW	Beryllium Associated Worker
BDW	Beryllium Designated Worker
Be SME	Beryllium Subject Matter Expert
Be-LPT	Beryllium Lymphocyte Proliferation Test
BeW	Beryllium Worker
CBC	Complete Blood Count
CBD	Chronic Beryllium Disease
CBDPP	Chronic Beryllium Disease Prevention Program
CBS	Chemical and Biological Safety Section
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CXR	Chest X-Ray
DAP	Discipline Action Plan
DOE	Department of Energy
eIWS	Electronic Integration Worksheet
ES&H	Environment, Safety and Health
FEV1	Forced Expiratory Volume in 1 second
FSP	Facility Safety Plan
FVC	Forced Vital Capacity
HAC	Hazard Assessment And Control Form
HCD	Hazards Control Department
HEPA	High Efficiency Particulate Air (filter)
HSD	Health Services Department
IHPIM	Industrial Hygiene Policy and Information Manual
IWS	Integration Work Sheet
LPT	Lymphocyte Proliferation Test
LSO	Livermore Site Office
LTRAIN	Livermore Training Records and Information Network
NIOSH	National Institute for Occupational Safety and Health
NNSA	National Nuclear Security Administration
OSHA	Occupational Safety and Health Administration
OSP	Operational Safety Plan
PEL	Permissible Exposure Limit
PIM	Policy and Information Manual
PWP	Project Work Plan
RPP	Respiratory Protection Program
SAD	Safety Analysis Document
SAR	Safety Analysis Report
SEP	Safety and Environmental Protection
SMA12	Group of Medical Blood Tests
SP	Safety Plan
WAC	Waste Acceptance Criteria
WSS	Work Smart Standard

Appendix B. Baseline Beryllium Inventory

The Table, “Buildings where Beryllium Work may have been Performed,” on the following page is the starting point for determining the baseline beryllium inventory. The basis for this table is the Hazards Control Analytical Laboratory database (ALIMS) for air and surface (swipe) samples and it covers the years 1962 – 1998. The basic assumption made is that if a beryllium sample was taken in a building, room, or on a piece of equipment some amount of beryllium work was done or presence of beryllium contaminated equipment was expected. This assumption is true in the majority of cases; however, beryllium analysis is part of an analytical suite (“California 17 metals,” “Pump Metals,” “IH metals”) and is done automatically, even if beryllium is not present. It is not possible to sort these data from the rest. Those buildings with a small number of surface samples (<25⁵¹) where beryllium work may not have been done are noted with shaded text.

In mid-1999 the GAO requested a audit of DOE beryllium activities, the ALIMS database was used to identify buildings and the number of air and swipe samples taken during the 1962 – 1998 period was taken a measure of the amount of beryllium related work done. See this report for specifics.⁵²

The major work was done in the following buildings:

- 231 Mechanical Engineering
- 241 Chemistry and Material Science Laboratories
- 321C Machine Shop for Toxic and Radioactive Materials

Lesser amounts of work were done in or at the following buildings and areas:

- 131 Engineering
- 235 Chemistry and Materials Science
- 391 National Ignition Facility
- 419 Hazardous Waste Management (formerly Decontamination Facility)
- 619 DUS Salvage Yard
- 801 Site-300 Firing Bunker
- 851 Site-300 Firing Bunker

This list has been augmented by a complete review of Hazard Control Department archived facility safety plans (FSP), operational safety plans (OSP), Hazard Assessments, project work plans (PWP), integration worksheets (IWS), and other relevant documents.

A limitation of the baseline inventory assessment is that, as noted in the database, in many areas only the “occupied space,” was evaluated. This is, areas in overhead spaces, above false ceilings, behind or under equipment, or similar inaccessible areas, *were not evaluated*.

The results of the Baseline Inventory are in the FileMaker Pro[®] database, “Baseline Inventory.” Active beryllium work areas are tracked in another FileMaker Pro[®] database, “HazAssess & Initial Monitoring.”

⁵¹ This number is somewhat arbitrary, but 25 represents less than 1 surface sample per year.

⁵² LLNL response to GAO Audit, August 1999.

Table. Buildings where Beryllium Work may have been Performed

102	226	324	514A	823B
111	227	325	516	824
113	228	326	523	826
121	229	327	545	827
131	231	328	551W	827D
132N	232	329	554	828
132S	233	331	591	829
134	234	332	612	830
141	235	340	614	831
151	239	341	615	832
153	241	343	616	834
154	243	345	617B	836
161	248	350	618	840
162	251	351	619	841
165	253	352	630	843B
165A	254	362	652	845
166	255	366	663	850
167	255W	376	691	851
168	261	378	801	851B
169	281	381	802	852
171	291	383	803	852B
172	292	391	804	854
173	294	392	805	854F
174	298	401	806	855
175	300	402	807	856
176	301	403	808	857
177	302	404	809	858
181	310	405	809A	859
182	311	411	809B	860
191	312	412	810	861
194	313	416	812	865
196	314	417	812E	871
197	315	418	814	874
212	316	419	816	875
213	320	431	817	877
219	321A	432	818	879
221	321B	435	819	880
222 ⁵³	321C	490	820	897
223	321E	494	821	
224	321W	511	822	
225	322	513	822B	
	323	514	823	

⁵³ Demolished

Appendix C. Current Beryllium Operations

This table lists operations that are currently being performed, or are planned. Two directorates, Biosciences and Computations Directorates, have no beryllium work as defined by 10 CFR 850. This table only lists work with beryllium that meets the 10 CFR 850 definition: “Beryllium” means “elemental beryllium and any insoluble beryllium compound or alloy containing 0.1 percent beryllium or greater that may be released as an airborne particulate,” or does not fall under the exemptions specified in 10 CFR 850.2(b)(1), for beryllium articles, or 10 CFR 850(b)(2), laboratory operations that meet the 29 CFR 1910.1450 definition of laboratory use of hazardous chemicals.

Work Authorization Document numbers are current as of the date of this CBDPP. They may change to meet Programmatic needs. For current Work Authorization Documents contact the responsible Directorate.

The locations in the table are generally specific as to building and room; however, in some cases, the description is more general (building number only), or group of building (eg, “612 Area”) implying that beryllium work can take place in any operational area (eg, laboratory or shop) within that building complex.

Directorate	Location	Description	LLNL Safety Document
Chemistry & Material Science	132N, Room 2878, 2898, 2699	Analytical laboratory doing particle analysis; planned work may involve beryllium.	FSP 132N
Chemistry & Material Science	235, Rooms 1121, 1131, 1133, 1136, 1138, 1215, 1251, basement	Research, beryllium metallurgy, beryllium coating, sputtering, inspection of beryllium under electron microscopes, ion implanter, accelerator, maintenance of equipment and facilities. Storage of beryllium metal.	FSP 235
Chemistry & Material Science	241, Rooms 1600, 1825, 1826, 1838, 1886, 1901	Legacy equipment present in High Bay, vault, and ventilation systems. Decommissioning of obsolete equipment. Storage of beryllium stock for x-ray windows. Previous activities: research, beryllium metal and compounds (including oxide), sputtering, machining, maintenance of equipment and facilities.	FSP 241
Chemistry & Materials Science	231, 1700 Area	Weld Development Laboratory: authorized work includes resistance, friction, electron beam, gas tungsten arc, or gas metal arc welding; surface preparation, inspection, and solder/torch brazing; maintenance of equipment.	B231 FSP, IWS/SO 12167
Chemistry & Materials Science	810	Inspection and assembly operations involving beryllium components	FSP S300.8
Defense & Nuclear	NTS, Field Test Areas	Research: inspection, assembly of explosive and non-explosive parts containing beryllium	FSP for the “BEEF” Facility is

Directorate	Location	Description	LLNL Safety Document
Technologies		components; explosive tests.	currently under development. All LLNL activities at NTS fall under the requirements of the ES&H Manual, with specific requirements in Volume 6, "Nevada Requirements"
Defense & Nuclear Technologies	Off-site Locations (such as Pantex, or Y-12)	Research: this includes sites where LLNL has primary responsibility (covered by the CBDPP) and other DOE/NNSA contractor sites where LLNL employees will be covered by that site's CBDPP.	Separate OSPs and IWSs will be developed to address hazards specific to individual areas where LLNL has primary responsibility prior to performing work.
Defense & Nuclear Technologies	Site-300 (Bldgs, 801A, 804, 812A, 812D, 834H, 836C, 836D, 850, 851A, 867, and Firing Tables	Research, hydrodynamic testing (test assemblies may contain beryllium components; firing tables: set-up of tests, post-test clean-up), maintenance of equipment (which may include beryllium articles), storage areas, and facilities. Shaker tables for mechanical testing. [Potential for regulated beryllium work area exists depending on activity.] Contained Firing Facility (operations will be similar to firing tables process, but in an enclosed chamber). Proposed activity: beryllium analytical laboratory.	FSP S300.1, FSP S300.2
Defense & Nuclear Technologies	Superblock (B-331 and B-332:1010, 1322, 1353, 1345, 1354, 1362, 1361	Research; Stockpile stewardship, facility and equipment maintenance, HEPA filter testing, decontamination and decommissioning of obsolete equipment. Majority of work is performed in gloveboxes for control of other hazards.	FSP 331, FSP 332
Energy & Environment (formerly Earth & Environmental Science)	190, Room 1000	Milligram quantities of BeO are used to produce ion beams. Periodic cleaning of ion source parts which may be contaminated with beryllium.	FSP 190
Engineering	131 High Bay, Rooms 1221, 1230, and all approved workspaces	The assembly, environmental testing, disassembly and inspection of components containing beryllium parts. Receive parts for inspection and	FSP 131 HB

Directorate	Location	Description	LLNL Safety Document
	and laboratories except offices, meeting rooms, break rooms, restrooms, and other rooms not approved for work with hazardous materials.	other programmatic work (which may contain beryllium or beryllium contamination) from other DOE/NNSA contractor sites. Cleaning, swiping, and repackaging operations. Beryllium storage activities.	
Engineering	141, Room 107	Molecular Beam Epitaxy (MBE): coating of wafers with layer(s) of other materials on controlled chemical composition by chemical reaction in a vacuum chamber. Maintenance of chamber and system. Approximately 1 gram of Be is stored in a crucible in the MBE.	OSP 141.27 (inactive)
Engineering	231 Vault	A variety of closed containers (drums, packages, etc.) containing Am241 sealed sources located in the B231 Vault will be opened, inspected, and repackaged for disposal. Several of the Americium sources contain Beryllium.	FSP 231 Vault
Engineering	231, Rooms 1000, 1600, 1640, 1829, 1841, 1867	Mechanical testing of beryllium parts; maintenance of equipment used for testing	FSP 231
Engineering	231, Rooms 1000-1018, 1600, 1640, 1678, 1829, 1841, 1867,	Mechanical Testing of Hazardous Materials, including beryllium.	FSP 231
Engineering	231, Rooms 1737, 1737 A-B, 1963, 1963A	Work activity involves developing methods of joining metals and their alloys(including beryllium).	FSP 231
Engineering	231, Rooms 1937, 1945 A-D	Metallography preparation of materials which includes sectioning, mounting, identification, grinding, lapping, polishing, cleaning, etching, and characterizing.	FSP 231
Engineering	231 Vault, 232 Fenced Area, 233 Vault	Opening storage drums and containers. Some drums and containers contain solid beryllium or beryllium oxide, most probably in closed primary containers (e.g., plastic bags).	FSP 231 Vault FSP 233 Vault and 232 Fenced Compound
Engineering	232 Fenced Area (Compound)	Shipping, receiving, onsite transportation and storage of controlled (radioactive, precious metals) and hazardous materials. Handling of packaged (not bare) beryllium/lithium hydride specimens of metal alloy or ceramic in a nondispersible form.	FSP 233 Vault and 232 Fenced Compound
Engineering	233 Vault	Shipping, receiving, storage of precious metals and classified parts, including beryllium.	FSP 233 Vault and 232 Fenced

Directorate	Location	Description	LLNL Safety Document
			compound
Engineering	321A, Room 1001A	Heat Treat Shop: heat treating and processing of beryllium parts.	FSP 321 Complex IWS/SP 11082
Engineering	321C, NC Shop: 1351, 1437, 1437A. 1437C, 2345, 2348	NC Shop: machining of beryllium and beryllium oxide. Cleaning of machined parts. Storage of beryllium stock and contaminated equipment. Maintenance of equipment and systems; collection of waste.	FSP 321 Complex, IWS/SP 11 622
Engineering	321C, Room 1318, 1348, 1348A, 1352, 1352A/B/F/G	Inspection Shop: inspection of finished parts of beryllium or beryllium oxide.	FSP 321 Complex IWS/SP 11433
Engineering	321C, Room 1351A	Operation to machine BeO is inactive and not planned for reactivation, but potentially contaminated machine tool s are still present.	inactive
Engineering	322, CEP Shop: 100, 109, 111	Chemical and Electrochemical Processes Shop: chemical and electrochemical etching, or cleaning of beryllium-containing parts (soluble beryllium compounds may end up in tanks).	FSP 321 Complex, IWS 11371
Engineering	329, various Rooms	Laser welding of hazardous materials including beryllium.	FSP 321 Complex IWS/SP 11060
Engineering	Sitewide, Machine Tool Services	Maintenance, repair, installation, and removal of machine tools that may contain beryllium.	FSP 321 Complex
Engineering	Storage Vaults: 131 Vault, 1341 All 131 High Bay MM operational areas Rooms 1341 & all Materials Management operational321C Vault, Room 1347A	Material Control & Accountability operations.	FSP 131 FSP 321 Complex
ICF/NIF	381, Room B156	Various beryllium components wrapped, sealed and stored. Small foils and filters are handled but are not physically modified.	OSP 381.50
ICF/NIF	381, Rooms 1533,1545	Beryllium foils are used for diagnostic purposes and stored in dry boxes. Foils are not physically changes and should not create dust.	OSP 381.13
ICF/NIF (formerly Lasers)	298, Rooms 102, 103, 106, 107, 108, 109, 112, 142, 143, 144, 145, 148, 181, 183, 189, 190, 191, 192,	Laser target development, fabrication, and characterization: operation and maintenance of various types of high frequency coaters and sources, plasma strippers, induction heaters, x-ray equipment, scanning electron microscopes, and the	OSP 298.25

Directorate	Location	Description	LLNL Safety Document
	193	handling radioactive and toxic (including beryllium) materials. 3 kg of Be in storage (25 g in use).	
ICF/NIF (formerly Lasers)	298, Rooms 184, 185, 187, and 188	Laser cutting and drilling: cutting and/or drilling of beryllium foils is performed in a vacuum chamber.	OSP 298.09
ICF/NIF (formerly Lasers)	391, Room 1303B, 1304B	Beryllium Coating Facility: coating of parts with beryllium in a vacuum chamber, maintenance of coating chamber and system. Beryllium is present as an anode (1 anode present in coater, 1-4 anodes in storage).	OSP 391.44
ICF/NIF (formerly Lasers)	391, Rooms 201 and 206, 213	201: beryllium foil is cut into windows, Be window storage 202: Legacy Be window storage 213: RGD beryllium windows storage	
ICF/NIF (formerly Lasers)	NIF, Planned Beryllium Operation	Beryllium will be present in diagnostic windows and target shells. Experiments leading to goal of controlled thermonuclear fusion by imploding and igniting a target capsule. Work will require entry of target chamber for experiment set-up and system maintenance.	NIF Draft Preliminary Safety Analysis Report
Laboratory Services (formerly Laboratory Site Operations)	Sitewide, Plant Engineering	Facility maintenance of structures (buildings) and systems (ventilation, plumbing, and other facility systems) used to control hazardous materials (including beryllium).	Operations are covered in generic IWSs, bridging documents for specific facilities are written as necessary
Non-Proliferation, Arms Control, International Security	132S	Beryllium articles: sealed sources with beryllium and windows in x-ray machines.	various IWSs for the Facility
Non-Proliferation, Arms Control, International Security	262 (the 261 Dome has been renumbered as building 262)	Beryllium is used as shielding in prefabricated shapes or is handled in sealed containers. Surface contamination shall be below $0.2\mu\text{g}/100\text{ cm}^2$.	FSP 262
Physics & Advanced Technology	194	Physics research, maintenance of equipment. Beryllium windows as articles are used in equipment.	FSP 194
SEP (formerly	Sitewide, Hazardous	Handling and processing of hazardous and mixed	FSP 151, FSP 514,

Directorate	Location	Description	LLNL Safety Document
Laboratory Site Operations)	Waste Management: 151, 514 Area, 612 Area, 695 Area, S-300	waste that contains beryllium, beryllium compounds and items contaminated with beryllium. Waste is sampled and picked up from Satellite Waste Accumulation Areas and processed through HWM facilities. Selected operations (some liquid waste treatment and storage) will be relocated to DWTF (695 Area) from existing facilities. Other DWTF activities include, but are not limited to, debris sorting and washing, uranium (contaminated with beryllium), glovebox operations). ⁵⁴	FSP 612, FSP S300.1; HWM employee Instructions and SOPs
SEP (formerly Laboratory Site Operations)	Sitewide, Hazards Control Department; 253 and 254	ES&H support of programmatic work involving beryllium (inspection, oversight, air and surface sampling, HEPA filter testing, chemical and radiological analysis in B-253), assist programs in facility and equipment maintenance. Detector and counting calibration, testing, and development.	FSP 253
Director's Office	Various	Decontamination, decommission and demolition of excessed facilities and equipment where beryllium work may have been done. (SAT Team activity.)	Separate OSPs and IWSs will be developed to address hazards specific to individual areas prior to performing work.
Various Directorates	Off-site	Emergency response. This activity is under management by DOE/NNSA Albuquerque and is subject to their CBDPP when there is a potential for beryllium exposure.	Emergency Response Procedures (March 1999).
Various Directorates	Various	Decontamination, decommission and demolition of excessed facilities and equipment where beryllium work may have been done. (Work done by personnel other than SAT Team.)	Separate OSPs and IWSs will be developed to address hazards specific to individual areas prior to performing work.
Various Directorates	Various	Maintenance of equipment and systems used for beryllium work.	Separate OSPs and IWSs will be developed to address hazards

⁵⁴ See letter from Karin King, Environmental Management Operations Team Leader, DOE/NNSA/LSO to Stephanie Goodwin, Division Leader, Radioactive and Hazardous Waste Management, LLNL, dated January 31, 2005, for specific conditions of approval for the Debris Washing and Uranium Deactivation at B-695.

Directorate	Location	Description	LLNL Safety Document
			specific to individual areas prior to performing work.

Appendix D. Exposure Reduction and Minimization Program for B-801, Contained Firing Facility

The following Exposure Reduction and Minimization Program applies to Building 801, Contained Firing Facility. This has been separately supplied to and approved by DOE/NNSA.

The full text of the Plan is:

Background: With respect to the employer responsibilities, 10 CFR 850.25(b)(1) states, “Where exposure levels are at or above the action level, establish a formal exposure reduction and minimization program to reduce exposure levels to below the action level, if practicable.”

On May 12, 2003, four workers in the Contained Firing Facility (CFF) received exposures adjusted for 8-hour time weighted average (TWA) but uncorrected for respiratory protection that exceeded the action level of $0.2 \mu\text{g}/\text{m}^3$. Although the cause for exceeding the action level was performing a sweeping operation with insufficient water during morning operations, air concentrations in the afternoon suggest that the TWA exposure levels could be at or above the action level during the first day of manual decontamination of the firing chamber for some experiments performed in the CFF.

In September, 2003, an experiment containing relatively large amounts of beryllium and explosives was performed. The experiment was conducted while implementing the controls from revision 0 of this plan. The film recovery for this experiment resulted in one employee exceeding the action level from beryllium levels on the film cassette. The manual decontamination of the chamber resulted in the action level being exceeded several times due the relatively high airborne concentrations created by the experiment. Although there are no particular controls that are certain reduce breathing zone concentrations to below the action level, revision 1 of this plan was written to incorporate improvements derived from the September 2003 experiment.

Scope:

This plan applies to data recovery from inside the firing chamber and the manual decontamination of the firing chamber after the performance of intentional detonation experiments containing beryllium and/or compounds of beryllium. The firing chamber will continue to be designated as a Regulated Beryllium Work Area (RBWA) during this time. There is a demarcation with warning signs at the contiguous buffer Beryllium Work Area (BWA) entry with appropriate labeling and posting. The 3-stage decontamination unit, including a doffing, showering, and changing area, will continue to be in use after work in the chamber as an RBWA. Respiratory protection and protective clothing will remain required for all work in the RBWA and buffer BWA during this manual decontamination.

Annual goals for exposure reduction and minimization:

The following exposure goals are set forth by this plan:

- a. The mean annual exposure (adjusted but uncorrected) for personnel performing manual decontamination of the firing chamber is $\leq 0.1 \mu\text{g}/\text{m}^3$ as an 8-hour TWA.
- b. The exposure (adjusted but uncorrected) for all personnel entering the firing chamber on the first day of manual decontamination of the firing chamber is $< 0.2 \mu\text{g}/\text{m}^3$ as an 8-hour TWA. Until decontamination techniques are mature, excursions above this goal are possible but workers will be protected by the use of Personal Protective Equipment (PPE).

Strategies, rationale, and actions for meeting annual goals for exposure reduction and minimization:

Strategy 1: Prior to manual cleanup of chamber remove as much contamination as possible from walls and air using engineering features of facility.

Rationale for Strategy 1: Although, the engineered features alone cannot adequately decontaminate the firing chamber, they are remotely operated so their aggressive employment prior to manual decontamination of the chamber reduces risk to personnel.

Actions to implement Strategy 1:

1. Continue practice of purging chamber for a minimum of 45 minutes after each intentional detonation experiment.
2. Use manually set-up, remotely operated wash-down apparatus to wash the chamber a minimum of three times after intentional detonation experiments containing beryllium prior to beginning manual decontamination activities.

Strategy 2: During manual cleanup, use ample water to thoroughly wet surfaces within the chamber to reduce the risk of airborne beryllium.

Rationale for Strategy 2: Operating experience has demonstrated that work on dry or merely damp (versus thoroughly wet) surfaces represents a higher risk to elevated airborne beryllium concentrations.

Actions to implement Strategy 2:

1. Revise firing chamber cleanup procedure to explicitly require surfaces to either be thoroughly wetted for cleaning or be completely wet prior to using any potentially abrasive cleaning technique.
2. Revise firing chamber cleanup procedure to ensure that debris pick-up is done wet and newly exposed surfaces created from debris pickup are wet down.
3. Investigate the use of low-foaming, non-polymer-based, surfactants in the wash water to reduce the surface tension of the water and possibly the suspension of airborne beryllium. Candidate surfactants will be tested outside the CFF to avoid jeopardizing filter function, evaporator function, and waste stream characterization prior to use in the facility.

Strategy 3: During manual cleanup and data recovery, develop and implement new cleaning and immobilization techniques that control the potential suspension of material.

Rationale for Strategy 3: Use of water as a work practice control for prevention of elevated airborne concentrations of beryllium should be supplemented by other controls and cleaning techniques that mitigate and prevent elevated airborne concentrations of beryllium.

1. Revise firing chamber cleanup procedure to check chamber ventilation prior to beginning manual decontamination.

2. Use local ventilation devices (e.g. vacuum cleaners) to control potential airborne contamination at the source and keep it away from worker breathing zones.
3. When practicable use water washing devices (e.g. water brooms, water spray devices) to clean.
4. Use of stay times to confirm the exposure potential associated with new types of cleaning equipment that will be used for manual decontamination.
5. Develop simplified designs for film cassettes that will minimize time and amount of disturbance required for disassembly after an experiment.
6. If film cassettes are damaged and cannot be thoroughly wetted, use spray-on encapsulant to immobilized contamination prior to disassembly.
7. Develop, maintain, and provide decontamination crew trainees with written "lessons learned" techniques that address positioning of personnel relative to high contamination areas, ventilation flow, and water spray. Develop cleaning tools as necessary to implement these "lessons learned."

Strategy 4: Investigate and implement the use of more comfortable respiratory protection with higher protection factors.

Rationale for Strategy 4: Although exposure under 10 CFR 850 is evaluated as uncorrected, additional protection factors for PPE still reduce the actual health risk to workers. More comfortable respiratory protection increases certain levels of safety that are associated with the implementation of administrative controls.

Actions to implement Strategy 4:

1. Investigate the certification and comfort of hood type respirators and various powered air purifying respirators.
2. Procure new types of respirators dedicated for use at the CFF to reduce reliance upon institutionally supplied respirators.
3. Set up facilities that allow the cleaning and re-use of respirators at CFF instead of exchanging respirators with institutional supplies after each use.

Tracking of exposure reduction and minimization:

Personnel entering the firing chamber before and during beryllium decontamination will continue to be required to wear personal sampling equipment. Exposure results will continue to be reported and distributed by the ES&H Team Industrial Hygienist. Area air samples will continue to be used to monitor chamber environment. Additionally, the following reports will be added:

1. Any exposure that shows that exposure goals of this report are not being met will be identified explicitly to NNSA/LSO in writing within ten working days of receipt of the results.
2. A summary report will be provided to NNSA/LSO by September 30, 2004 summarizing how the exposure goals of this plan have been met and recommending continuation, modification, or discontinuation of this plan.

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